

ON SOME SOUTH-AFRICAN
PHYLLOPODA

RAISED FROM DRIED MUD

BY

G. O. SARS

WITH 4 AUTOGRAPHIC PLATES



²₃ KRISTIANIA
ALB. CAMMERMEYERS FORLAG
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On some South-African **Phyllopoda** raised from dried mud.

With 4 autographic Plates.

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Introduction.

On the 13th April of last year (1897) I received, through the kindness of Mr. J. V. Hodgson of the Biological Association of Plymouth, a considerable quantity of dried mud taken by his brother from a shallow lake («vley») in the neighbourhood of Port Elizabeth, Cape Colony. Though the mud at first sight did not present any promising aspect, it was found, on a preliminary microscopical examination, to contain a quantity of ephippia of a *Daphnia*, and detached valves of one or two species of *Cypris*. Moreover, some fragments of the carapace of an *Apus*, and of the shell of an *Estheria*, were detected, and these facts seemed indeed to prove that the mud was serviceable for hatching operations. These were immediately entered upon, several aquaria being arranged to receive small parcels of the mud. My first attempts, however, were by no means successful, probably owing to the comparative lowness of the temperature at that time. But in the course of the following month (May), when warm, sunshiny weather prevailed, the hatching went on in

my aquaria rather successfully, especially after an attempt had been made to cleanse the mud from the superfluous clay-particles by sifting it gently through a bag of fine muslin. Among the several forms of Entomostraca raised from the mud during the course of the summer, there were also 4 different species of *Phyllopoda* belonging to the 3 leading groups of that suborder, and I propose in the present paper to restrict myself to an account of these interesting forms, intending to treat of the other Entomostraca in another paper to be published shortly.

The plates accompanying the present paper have been prepared with the greatest care by the autographic proceeding, and all the habitus-figures are copies from coloured drawings made from fresh, still living specimens, seen in their natural attitudes.

1. *Apus numidicus*, Grube.

(Pl. I.)

Apus numidicus, Grube, Ueber die Gattungen Estheria und Limnadia und einen neuen Apus (Archiv f. Naturgeschichte, Jahrg. XXXI), p. 75, pl. XI, fig. 14.

Syn.: *Apus dispar*, Brauer.

Specific Characters.—Carapace comparatively small and flattened, especially in the male, where it is almost circular in form, being more oval in the female, posterior sinus not very deep, and scarcely angular at the bottom, lateral lobes acute, dorsal keel distinct as far as the cervical sulcus. Exposed part of body very slender, cylindric, comprising in female about 25, in male 30 segments, and exceeding the median length of the carapace in male by nearly $\frac{1}{3}$ of its length. Caudal (non-pedigerous) segments in female 11, in male 14. Eyes large reniform, slightly diverging behind; postocular tubercle of considerable size, semi-oval abruptly cut off behind, and carrying on the tip a small circular knob. First pair of legs with the endites very slender, filiform, the 4th one about equalling in length the carapace. The 2 succeeding pairs of legs differing somewhat in the two sexes, being much stronger in male than in female, with the endites more robust, terminal joint in both sexes well developed, though shorter than the 4th endite, and minutely denticulate inside. Caudal filaments not particularly long, scarcely exceeding half the length of the body, and very distinctly and regularly articulated

throughout. Colour, in the living state of the animal, leathery brown, edges of carapace darker, eyes dark brown, encircled by a broad, bright red margin, outer appendages of the exposed legs beautiful coral-red. Length of fully grown male (not including the caudal filaments) 30 mm.; that of female about the same.

Remarks.—The description given by Grube of his *Apus numidicus* is certainly from a very young specimen of only 18 mm. length, but I do not find anything in his description and figure which could forbid an identification of the South African form with that species. I am also of opinion that the *Apus dispar* of Brauer¹⁾ is the same species; whereas the *Apus sudanicus* of the same author is apparently distinct, being of less slender form, and having a smaller number of caudal segments. From the well-known European species *Apus cancriformis* the present species is at once distinguished by the comparatively much smaller size of the carapace, and the length and slenderness of the exposed part of the body. In this respect it is much more nearly related to the Australian species, *Apus australiensis*, described by Messrs. Spencer and Hall²⁾, and in both these species there is a much greater number of caudal (non-pedigerous) segments present than in the European form, in which only 7 such segments are found.

General description of the male.

The dimensions of the largest specimen examined are as follows:

1) Sitzungsberichte d. K. Akad. d. Wissensch. in Wien, Vol. LXXV, Part 1, p. 589, Pl. I.

2) Crustacea of the Horn Expedition, p. 231, Pl. 20. figs. 1—3.

Total length of body from the frontal edge of the carapace to the end of the last caudal segment.....	30 mm.
Length of carapace.....	15 —
Greatest width of same.....	11 —
Median length of same.....	12 —
Length of exposed part of body.....	18 —
Median length of exposed pedigerous part of body.....	9 —
Length of caudal part of body.....	9 —
Width of exposed pedigerous segments.....	3 —
Width of last caudal segment.....	2 —
Length of 4th endite of 1st pair of legs.....	15 —
Length of caudal filaments.....	15 —

As will appear from these dimensions, and from an examination of fig. 1 on Pl. I, the general form of the body is very slender, much more so than in the European species *Apus cancriformis*, and even more than in the Australian species as represented by Messrs. Spencer and Hall, resembling more in this respect the North American species *Apus lucasanus*, Packard, or perhaps still more *Apus longicaudatus*, Leconte.

The carapace is comparatively of rather small size, scarcely occupying half the length of the body, and is almost circular in form, though the length somewhat exceeds the width. It is but slightly vaulted, and has the cervical sulcus very distinctly marked, exhibiting in the middle the convex mandibular segment. The frontal part of the carapace is evenly rounded anteriorly and rather convex above, carrying on its most elevated part the eyes and the post-ocular tubercle. From the cervical sulcus extends a well-marked keel along the middle of the back to the posterior sinus of the carapace. The latter is not very deep, and quite evenly rounded at the bottom, its edges being armed

with minute denticles, the number of which varies in different individuals. The lateral lobes of the carapace, flanking the sinus, terminate each in an acute point. On each side of the carapace the shell-gland is fairly distinct, extending from the cervical sulcus obliquely backwards. As to structure, the carapace is very thin and flexible, semipellucid, and exhibits a perfectly smooth and polished surface.

The exposed part of the body is very slender, cylindrical, and fully as long as the carapace, exceeding the median length of that part by about $\frac{1}{3}$ of its length. It comprises about 30 segments, the 16 anterior of which more properly belong to the trunk or mesosome, as they are provided with legs. But no distinct boundary exists between these segments and the 14 posterior, non-pedigerous segments, which represent the caudal part of the body or the tail. All these segments are very sharply defined, and each provided above with a transverse row of short spinules, this row, in the caudal segments, being also continued on the ventral side. The last segment (see figs. 5, 6) is considerably larger than the preceding ones, equalling in length about 3 of them combined, and it is quadrangular in form, and somewhat flattened. It exhibits dorsally on each side a nodiform prominence clothed with a few small spinules, and has at the base of the caudal filaments outside a few somewhat larger spines. The posterior edge of its dorsal face is transversely truncated, without any trace of a caudal plate, and that of the ventral face (see fig. 6) appears deeply emarginated; between them the fleshy lips bounding the anal orifice are seen to project.

The caudal filaments are not particularly long, scarcely attaining half the length of the body, and are, as a rule, but little divergent. On a closer examination, they are found to consist of numerous short and rather regular

articulations, each having 2 circlets of delicate bristles, the one at the end, the other about the middle (see fig. 7).

General description of the female.

The dimensions of the largest female specimen examined, which agrees exactly in length with the above described male, are as follows:

Length of carapace	17 $\frac{1}{2}$ mm.
Median length of same	15 —
Greatest width of same	12 —
Length of exposed part of body	16 $\frac{1}{2}$ —
Length of exposed pedigerous part	8 —
Length of caudal part	8 $\frac{1}{2}$ —
Length of caudal filaments	17 —

The differences in the body-proportions of the female and the male will be at once apparent, on comparing the above given measurements with the corresponding ones of the male, and a glance at figure 2 will give a still better idea of the extent of these differences.

As seen from the figure, the form of the body is on the whole less slender than in the male, the carapace especially being considerably larger in proportion to the exposed part of the body. Its form is also somewhat different, being more oval than in the male, with the length considerably exceeding the width. The cervical sulcus, the eyes and postocular tubercle, as also the dorsal keel and the posterior sinus do not exhibit any obvious difference from those parts in the male.

The exposed part of the body does not quite attain the length of the carapace, though somewhat exceeding (by its last segment) its median length. It is of a similar

narrow cylindric form to that in the male, but comprises only 25 segments, the 14 anterior of which are pedigerous. Of non-pedigerous or caudal segments there are accordingly only 11, instead of 14, as in the male. The last segment does not exhibit any difference from that in the male. The caudal filaments, on the other hand, are comparatively more elongated, somewhat exceeding half the length of the body. Their structure, however, is exactly as in the male.

The female may, moreover, easily be recognised by the transformation of the 2 outer appendages of the 11th pair of legs to egg-capsules. When these capsules, as is generally the case in adult specimens, contain eggs, they are also easily traced in the dorsal view of the animal, shining through the lateral lobes of the carapace on each side of the posterior sinus (see fig. 2).

The colour in both sexes is a more or less distinct leathery brown, somewhat lighter in the male than in the female, and sometimes changing into red ochre. This colour, however, in preserved specimens, very soon disappears, and is replaced by a uniform, yellowish green hue. As the carapace is semipellucid, its lateral parts appear lighter than the frontal and median parts where the dark body shines through it; its edges, as also the spinules fringing the posterior sinus and those encircling the exposed segments, are tinged with chestnut. The eyes are dark brown, and are surrounded by a rather broad, bright red margin. The outer appendages (exopodite and epipodite) of the legs, especially of those exposed behind the carapace, exhibit a beautiful coral-red hue. Through the exposed part of the body the capacious intestinal tube with its dark contents may be faintly traced.

As to the several appendages of the body, they are built much as in other species of the genus, and I do not therefore consider it necessary to give a detailed description of them.

The endites of the 1st pair of legs, as in the other species of the genus, are very slender and elongated, filiform, and project laterally from the sides of the carapace, pointing in different directions. The outermost, or 4th endite, which is more or less recurved, is almost as long as the whole carapace.

The 2 or 3 next succeeding pairs of legs are much larger in the male than in the female, though on the whole built upon the same type (comp. figs. 3 and 4). The terminal joint, or 5th endite, is well developed in both sexes, having the character of a strong claw, the outer edge of which exhibits a dense ciliation, whereas the inner, straight edge is minutely denticulated throughout. The 4th endite is much larger and thicker in the male (see fig. 3) than in the female, reaching considerably beyond the terminal joint, and its inner edge is coarsely serrate.

The 11th pair of legs, as usual, look very different in the two sexes. Whereas in the male, this pair does not differ essentially from those preceding and succeeding them, in the adult female they are peculiarly modified, to form, by the aid of the exopodite and epipodite, a box-like capsule, in which the eggs apparently become surrounded by their firm envelope. Not more than 2 or 3 eggs were found simultaneously in each of these capsules, the eggs being deposited at short intervals, to give place to others.

As to the total number of legs, it is a matter of great difficulty to state it with exactness, as the hindmost pairs are so extremely small, and so densely crowded together as

scarcely to admit of being counted, several pairs being attached to each segment. Whereas the anterior 12-14 pairs are covered by the carapace, the posterior pairs are wholly uncovered, forming a dense fringe on each side of the exposed part of the body. The hindmost pairs, however, are so small as not to project laterally, and they are only visible on viewing the animal from the ventral face, when they are seen to terminate the dense, conically tapered crowd of legs.

Development.—The eggs contained in the mud received seem to have been rather numerous, but they were not easy to detect, owing to their being so thickly coated with argillaceous matter as to look merely like small mud-particles. I have, however, once succeeded in observing such an egg at the moment of hatching (see fig. 8). It burst on one side, and from the opening a clear bladder was seen to project containing the fully-developed red-coloured Nauplius, which moved rather energetically within the capsule. Fig. 9 represents this hyaline capsule, with the enclosed Nauplius in a lateral position, after being separated from the egg-shell, and fig. 10 the just hatched Nauplius, viewed from the ventral face. Its length in this 1st free stage somewhat exceeds half a millimeter. Of limbs there are present only the 3 usual Nauplian appendages, all belonging to the head, viz., the antennulæ, the antennæ and the mandibular legs, arranged around the exceedingly prominent labrum. The posterior part of the body is quite simple, oval in form, and without any appendages or projections, though a faint transverse striation is visible on each side as the indication of an incipient segmentation. In front of the labrum the simple eye, or ocellus, is fairly distinguishable, but of compound eyes no trace is as yet to

be detected. Nor is the carapace as yet clearly distinguished, though a slight folding of the skin on each side of the dorsal face undoubtedly indicates the incipient formation of its lateral parts, as in each of these folds the shell-gland is distinctly traced (see fig. 9). The motions of the larva are at first rather imperfect and clumsy, being effected by irregular strokes of the natatory antennæ. It is only after the 1st exuviation has taken place, and the setæ of the antennæ have thereby acquired their plumose garniture, that the rhythmical movements characteristic of the later larval stages, are observed. The development of the larva goes on very rapidly, and after only 24 hours it has assumed the appearance represented in fig. 11, which is drawn from the very same individual, after the lapse of the above-named time. It may now be easily recognized as the offspring of an *Apus*, the carapace being already distinctly developed, and the legs in process of formation. The successive changes are easily understood. They consist in the gradual lengthening of the body, the development of additional legs, and the prolongation of the terminal stylets to the caudal filaments. The natatory antennæ still retain their character as the chief locomotory organs; but when the anterior pairs of legs have become more fully developed, a gradual reduction of these limbs, as also of the mandibular legs, may be observed to take place, and at last not even the slightest rudiment of these 2 pairs of limbs, so powerfully developed in the early stages of the larva remains. The animal has now entered the post-larval period of development, during which no other changes are observed than the general growth of the body and the development of additional legs behind the others.

Biological Observations.

Several specimens of this Phyllopod were reared in my aquaria, and they were watched nearly every day during the whole summer. They became sexually mature after the lapse of about a month, but had at that time scarcely attained half their definitive size. The shedding of the skin was effected at rather short intervals during the whole time in which they were observed, and at each exuviation the animal increased considerably in size. It was seen to feed eagerly upon the smaller forms of Entomostraca developing in the aquaria, and also to beat off the soft parts of aquatic plants growing on the bottom. In order to secure the undisturbed development of the other Entomostraca, which were also objects of my investigations, I transferred the greater number of the specimens to a single aquarium, feeding them, as a rule, every day with some soft parts of aquatic plants, which I had found that they devoured with great appetite. Indeed they seemed to thrive very well on this aliment, and increased rapidly in size, though the water in the aquarium became at last very turbid, partly from their excrements, partly by their constant stirring up of the loose muddy deposit from the bottom. The turbid state of the water prevented me from watching the specimens more closely; but whenever some fragments of plants were thrown into the aquarium, they at once came up to the surface seizing with greediness the articles between their legs, and, sinking down to the bottom with their booty, they devoured in a very short time all the softer tissues. Hoping in this manner to rear the specimens to full growth, and perhaps also to secure the deposited eggs for subsequent hatching experiments, I continued these

proceedings for rather a long time. But it appeared that the number of specimens was at last diminishing in a suspicious manner, though no disease whatever could be observed in those which at times came up to the surface to seize the food. A closer examination of the aquarium at once revealed the cause of this strange decrease of specimens. Not content with the vegetable food, which they had in abundance, they were impelled by their voracious nature to attack each other, and on the bottom of the aquarium the mutilated bodies of several specimens were found, some of which still showed signs of life, though the greater number of the legs had been torn off by their companions. Two of the specimens a male and a female, were now placed in another aquarium arranged with great care, and, as a rather rich supply of food, consisting both of smaller Entomostraca and vegetable fragments, was constantly thrown into it, I hoped that at least these two specimens would live in good terms with each other, and perhaps give rise to a new generation. But this attempt also failed of success. The love of the male assumed at last a very brutal character, and one day it was seen carrying the body of the female between its legs in a very pitiful condition, most of the soft parts having been torn off by her cannibal mate. At last only 2 specimens, a male and a female, remained¹). These I placed in 2 separate aquaria, both richly supplied with food, in order to watch their growth as long as possible. I had them living until the close of August, their age being estimated to be about 3 months. As at that time they seemed to have attained

¹) Some few specimens were, however, at an earlier period secured for the sake of anatomical examination.

their maximum size, and, moreover, showed traces of disease, they were taken up and preserved, after a careful drawing of each had been made, when still alive.

The movements of the animal are very vivacious, and it is very unusual to see it resting in the same place for any length of time. The movements are chiefly effected by the rhythmical strokes of the legs, though the very flexible tail may also assist in the movement. More frequently it swims with its back upwards, and this is always the case when it keeps on the bottom. On swimming through the water, however, it is sometimes seen to turn over, and when it reaches the surface, the belly is generally turned upwards. At other times it is seen climbing the stems and branches of the aquatic plants with great dexterity, in search of food, twisting its extremely flexible body in all directions. When in motion, the 1st pair of legs are extended laterally, with the slender endites projecting from the sides of the carapace, and pointing in different directions. It is therefore very probable that these parts chiefly serve as tactile organs. The next succeeding pairs, which are more or less incurved, are used as powerful prehensile implements, by which the food is seized and brought to the mouth, whereas the posterior pairs seem to be wholly devoted to respiratory purposes. In those legs which are exposed behind the carapace, the outer appendages (exopodite and epipodite) are found, in the living animal, to be in uninterrupted, rapid, vibratory movement, whereby a constantly renewed current of water from behind forwards is produced beneath the carapace.

It is a curious fact that of the present species male specimens were present in about the same number as female ones, whereas in the European species, as is well known, male specimens are extremely rare.

Distribution.—The specimens examined by Grube were taken by Dr. Strauch from a lake off Bonsanda in Algeria. The *Apus dispar* of Brauer, which I regard as the same species, was raised by that author from dried mud taken from a swamp off Tura el Chadra in Upper Egypt

2. *Streptocephalus gracilis*, G. O. Sars, n. sp.

(Pl. II).

Specific Characters.—Body in both sexes very slender and elongated, with the posterior division much longer than the anterior. Head of about the same size in the two sexes, in female evenly rounded in front, in male produced to a conical projection, slightly emarginated at the tip. Trunk simple, cylindrical, with none of the segments expanded laterally. Genital region comparatively small, scarcely exceeding the 1st caudal segment in length; marsupial pouch in female long and narrow, extending to the end of the 4th caudal segment. Tail very slender, and, not including the caudal rami, considerably exceeding the trunk in length. Caudal rami of the same appearance in the two sexes, about $\frac{1}{4}$ the length of the tail, narrow, slightly incurved, tapering gradually towards the end, marginal setæ very strong, densely crowded together, and finely plumous, except those of the distal part of the inner edge, which are rather short and spiniform. Antennæ in female simple, blade-like, each terminating in a short, somewhat recurved point; those of male very much elongated, and bent in a sigmoid manner, basal part armed at the end outside with a strong, incurved claw, terminal part very flexible, cylindrical, abruptly bent in the middle, and terminating in a slightly

dilated didactyl hand, dactyli slender, unequal, each having at the base an obtuse projection. Branchial legs with a single, smooth basal plate, terminal lobe of endopodite broad, sub-angular, and, in the middle pairs, armed at the inner angle with 4 curved spines. Body highly pellucid, with a very slight greenish or yellowish tinge. Length of fully grown female 20 mm., of male 21 mm.

Remarks.—At first I thought that this form might be the *Branchipus caffer* of Lovén, which likewise is from South Africa, and which undoubtedly belongs to the genus *Streptocephalus*; but the very short diagnosis given by Lovén does not suffice for a reliable specific determination, and indeed, the notes subsequently given by Brauer¹⁾ on an examination of some authentic specimens of this form preserved in the Zoological Museum of Berlin, show that Lovén's species is different from the one here described. It would seem to be more nearly allied to the *Branchipus rubricaulatus* of Klunzinger²⁾ from the northern part of Africa, though differing also from this species in several points.

Description.—The length of fully grown female specimens, measured from the front to the tip of the caudal rami, amounts to about 20 mm., that of the male to 21 mm.

In both sexes the body (see figs. 1 and 2) is very slender and elongated, exhibiting, in the living state of the animal, a slight sigmoid curve. The 2 chief divisions of the body are well defined, the posterior one being considerably longer than the anterior. The latter, as usual, is composed of the head and trunk, the latter of the genital region, and the tail.

¹⁾ Sitzungsber. d. K. Akad. d. Wiss. in Wien. 1877.

²⁾ Zeitschrift f. wiss. Zool., XVII, 1866.

The head is not very large, and exhibits somewhat behind the middle a distinct transverse suture joining the upper ends of the mandibles. By this suture the hind part, or cervical segment, is pretty well defined from the anterior part, and it expands on each side to a rounded lobe, within which the shell-gland is visible. The frontal part of the head in the female is evenly rounded, whereas in the male it projects to a short conical prominence slightly notched at the tip (see fig. 4).

The trunk, or mesosome, is composed of 11 well-defined segments of uniform size and simple cylindrical form, each carrying a pair of branchial legs.

The genital region is rather short, scarcely longer than the succeeding caudal segment, and is composed of 2 segments, which are partly coalesced, though distinctly defined dorsally. From the ventral side of this region in the female (fig. 1) the slender marsupial pouch issues, extending, when fully developed, beyond the 4th caudal segment. In the male (fig. 2) this pouch is replaced by 2 comparatively small, juxtaposed appendages containing the outer part of the vasa deferentia.

The tail proper is very slender, cylindrical, and, not including the caudal rami, exceeds the whole trunk in length. Of its 7 segments, the 6 anterior are of about equal size and are considerably longer than they are broad, whereas the last segment is rather short and obtusely produced between the insertion of the caudal rami (see fig. 12). In the male (fig. 2) the posterior segments are clothed on the upper face with numerous small tubercles, each carrying a delicate sensory hair.

The compound eyes (see figs. 1, 2, 4), as in other Branchipodids, are pedunculated and freely mobile, extend-

ing, as a rule, laterally. They are claviform in shape, with the outer pigmented part, or the eye-ball, evenly rounded off. Between them, in the middle of the front, the simple eye, or ocellus, is distinctly observable as a small dark spot.

The antennulæ (*ibid.*) are rather elongated, fully attaining the length of the head, and are very delicate, filiform, in the living animal being extended in front, and somewhat divergent.

The antennæ, as usual, are very different in the two sexes. In the female (see figs. 1 and 3) they have the character of 2 simple, oblong oval blades hanging down from the head, and each terminating in a short, somewhat recurved point. They seem to be quite immovable, and have the edges densely clothed in their outer part with delicate sensory hairs.

In the male these antennæ are greatly developed, and of a very peculiar structure (see figs. 2, 4, 5). When fully extended, they equal in length the whole anterior division of the body; but, as a rule, they are folded in beneath the head, forming a sharp sigmoid curve (see fig. 2). They each consist of a thick cylindrical basal part and a very flexible terminal part of more than thrice the length of the former. The basal part is very muscular, and is armed at the end outside with a strongly chitinized slender claw curving inwards. The terminal part is narrow cylindrical in form, and of a very soft consistency, with numerous transverse folds. It exhibits in the middle an abrupt, almost genicular bend, its distal part being doubled upon the proximal part, and somewhat beyond this bend it carries below a number of irregular tentacular papillæ. At the end it expands to a hand-like dilatation defined from the cylindrical part by a well-marked constriction, and prolonged into 2 narrow digitiform processes, which cross each other at the base (see figs. 5 and 6). This apical part of the

antennæ, which thus forms a kind of chela curving backwards, has the upper edge (in the normal attitude of the animal) minutely denticulate and terminating in a projecting corner, whereas each of the digitiform processes exhibits at its base an obtuse prominence pointing in the opposite direction. The processes are of rather unequal length, the lower one (in the normal attitude of the animal) being about $\frac{1}{3}$ longer than the upper, and having its outer part gently curved.

Of the oral parts, the labrum and the mandibles are easily observable, and exhibit quite a normal structure. The maxillæ, on the other hand, cannot be examined without dissection. The anterior maxillæ (fig. 7), as usual, consist of a thick basal part and an incurved, very mobile lamella carrying on the straight, distal edge a regular series of slender, biarticulate setæ curving inwards to the oral orifice. The posterior maxillæ (fig. 8) are very small, forming 2 simple, rounded lobes, which carry on the end a number of short densely ciliated setæ.

The branchial legs, as in all true Branchipodids, number 11 pairs. They increase in size successively from the 1st to about the 5th or 6th pair, from thence diminishing somewhat more slowly posteriorly, the 1st pair being much the smallest. In all pairs (see figs. 9, 10, 11) the following parts are to be distinguished; the stem proper, or endopodite, the exopodite, the epipodite, and the basal plate. The endopodite is rather broad and flattened, with the anterior face somewhat convex, the posterior concave. It terminates in a broad, subangular lobe fringed with short, ciliated setæ. In the middle pairs (fig. 10) the inner corner of this lobe is, moreover, armed with 4 short spiniform, projections curving outwards. Above this lobe, the inner edge of the

endopodite is divided into 5 setiferous lobules, the 3 inferior of which are rather small and conical in form. Of the 2 remaining lobules the upper one is much the larger, and, like the other, is densely fringed with a regular series of very delicate, upward-curving setæ. The exopodite has the form of an oval lamella movably articulated to the stem, outside its terminal lobe. This lamella is rather large, greatly constricted at the base, and fringed all round with strong, ciliated setæ. The epipodite, which morphologically constitutes the true gill, is attached to the outer side of the stem, at some distance from the exopodite, and has the form of a comparatively small sac-like lamella, without any setous armature, but of a peculiarly spongy structure. Just above this lamella the basal plate issues with a broad base from the stem. It is very thin and pellucid, oval, or elliptical in form, and has the edges perfectly smooth.

The 1st pair of legs (fig. 9), as above stated, are much smaller than any of the others, and have also the exopodite comparatively less fully developed. In the 11th, or last pair (fig. 11) the terminal lobe of the endopodite is less broad than in the other pairs, being almost cordate in form; and the setæ of the inner lobules are much reduced in number, and are rather short. The epipodite has lost its branchial structure, and assumed the character of a simple plate, the terminal edge of which exhibits a number of coarse serrations. The basal plate is fully as large as in the other pairs.

The marsupial pouch (see fig. 1), as above stated, is very slender and elongated, almost cylindric in form, though terminating in an acute point, which forms one of the lips defining the valvular opening, through which the ova are expelled.

The outer sexual appendages of the male (see fig. 2) are comparatively short, extending but little beyond the genital region, and they gradually taper towards the end. They each have, somewhat beyond the middle, a slight notch, but are otherwise quite smooth.

The caudal rami (see fig. 12) are about $\frac{1}{4}$ as long as the tail, and of the same appearance in the two sexes. They are rather slender and slightly incurved, and they taper gradually from the base to the tip. The marginal setæ are very strong and finely ciliated, forming a dense fringe, which, on the outer edge, is quite uninterrupted, comprising about 30 setæ gradually increasing in length to about the middle, from thence rapidly diminishing in size. On the inner edge there are about 16 similar setæ; but on its distal part these setæ are replaced by short, unciliated spines.

Of the inner organs, the intestine may be very distinctly traced through the thin pellucid integuments (see figs. 1 and 2). It extends as a cylindrical tube through the axis of the body, and exhibits yellowish contents, which change towards the posterior end to a dark brown. In the fore-part of the head, this tube is joined by the short, ascending œsophagus, and forms here on each side a rounded, densely lobular cæcal expansion answering to the so-called liver in other Phyllopoda. In the last caudal segment, it terminates in a short, muscular rectum, which debouches on the obtusely produced tip of that segment, between the insertion of the caudal rami (see fig. 12).

The heart is easy to detect in living specimens, on account of its rapid pulsations. It extends through the greater part of the body, just above the intestinal tube, and in each segment exhibits a pair of valvular venous sinuses.

The ovaria are wholly confined to the tail and the genital region, and extend in the form of 2 narrow tubes along the intestine as far back as to the middle of the antepenultimate caudal segment. The ova contained in the marsupial pouch are generally arranged in 4 longitudinal rows, and are partly concealed by the richly ramified glutinous gland.

The testes form 2 rather narrow bags confined to the anterior genital segment, each sending off a somewhat flexuous duct, which enters the corresponding sexual appendage, debouching on its tip.

As to colour, the body in both sexes is highly pellucid, with only a slight greenish or yellowish tinge. The caudal rami never exhibit, as in most other species, any trace of pigmentation.

Biological Observations.

Rather a large number of specimens of this beautiful form developed in my aquaria, and were watched during the whole summer. They rapidly passed through their larval stages, and in the course of about a fortnight reached to maturity. Male and female specimens were present in about the same number, the former being at once recognized by their enormously developed antennæ. The swimming motions of the animal are very graceful, constituting, as a rule, a perfectly even dart through the water in various directions, during which the belly is always turned upwards. These movements are chiefly effected by the almost uninterrupted, rhythmical swinging of the branchial legs, the tail being used merely as a steering apparatus, twisting now to one, now to the other side, according to the direction of the course. The animal is, however, also enabled, by a

sudden bend of the tail, to start away with considerable speed, and its capture with the ordinary dipping-tube is therefore connected with no little difficulty. More frequently the specimens were seen swimming about near the surface of the water, never burying themselves in the bottom-deposit or ascending the stem and branches of the aquatic plants, as is the case with the *Apus* and *Estheriæ*. Their food seemed exclusively to consist of small particles of animal or vegetable matter, which, by the swinging of the branchial legs, are whirled in between them and carried forward to the mouth. Though several male and female specimens occurred together in the aquaria, I never succeeded in witnessing the copulative act, and I cannot therefore state, in what manner the peculiarly transformed antennæ of the male are used. It cannot, however, be doubted, that they are prehensile organs, by the aid of which the female is seized, and that the strong claws issuing from the end of the basal part may serve for getting a firm grasp of her; but on the other hand, it seems equally difficult to imagine what can be the function of the soft terminal part with its likewise rather fragile chela, and to conceive the signification of the peculiarly developed frontal appendages in other male Branchipodids. The females several times deposited their eggs, but no new generation was seen to develop from these eggs, though the aquaria were kept for observation far into the autumn.

3. **Branchipodopsis Hodgsoni**, G. O. Sars, n. gen. & sp.
(Pl. III).

Specific Characters.—Body less slender than in the preceding form, with the tail much shorter. Head considerably larger in male than in female and without any frontal lobes. Trunk slightly depressed, with the segments simple, not expanded laterally. Genital region in female very large, about equalling in length half the trunk, that of male considerably smaller. Tail, not including the caudal rami, scarcely attaining half the length of the preceding part of the body. Antennulæ, especially in male, very much elongated. Antennæ in female simple, blade-like; in male short and robust, basal part very massive, being produced inside to a thick conical prominence bidentate at the tip, and carrying at the end inside a small linguiform lobe, terminal part forming a strong incurved claw. Oral parts normal. Branchial legs with a single, coarsely serrate basal plate, terminal lobe of endopodite rather broad, and having the inner corner, in the middle pairs, produced to a blunt, tooth-like projection. Marsupium in female confined to the genital region, and forming a very capacious sac-like expansion, not prolonged beyond its limits. Sexual appendages of male of normal appearance. Caudal rami very different in the two sexes, being of quite an unusual size in male, and curved like a pair of much bowed tongs, outer edge and proximal part of inner one fringed with comparatively short setæ, distal part of inner edge armed with small acute teeth, tip curled up in front. Body pellucid, with a faint

yellowish or reddish tinge, caudal segments in fully grown specimens generally banded ventrally with orange, marsupium of female richly coloured with orange, crimson and blue, caudal ramæ in male tinged with light orange. Length of fully grown female 12 mm., of male about the same.

Remarks.—The present form cannot properly be referred to any of the hitherto established genera and subgenera of Branchipodids, and I have therefore felt justified in establishing for its reception a new genus, which is named as above on account of a certain resemblance to the genus *Branchipus* (sens. strict.). The total absence of any frontal appendages in the male is a character which this genus shares with the genus *Branchinecta*; but in the latter the marsupium of the female is prolonged to a narrow pouch as in *Streptocephalus*, and the caudal rami are very different. Moreover the ovaria are not, as in *Branchinecta*, contained within the trunk, but are confined to the tail and genital region, as in most other Branchipodids. At first I was inclined to regard the present form as identical with the *Branchipus abiadi* of Brauer; but on a closer comparison I find that it differs in so many essential points, that it must evidently be regarded as specifically distinct, though Brauer's species ought undoubtedly to be included in the same genus. I have much pleasure in dedicating this interesting form to the distinguished zoologist Mr. J. V. Hodgson, to whom I am indebted for the material from which this, and the 3 other Phyllopoda here described were reared.

Description.—The length of fully grown female specimens, measured from the front to the end of the caudal rami, does not exceed 12 mm., and male specimens are scarcely larger.

The form of the body (see figs. 1 and 2), as compared with that in the preceding species, appears somewhat shorter and thicker, and the proportions of the several sections is rather different. The head in the female (fig. 1) is of a similar shape to that in *Streptocephalus gracilis*. In the male (fig. 2) it is comparatively larger, and its frontal part exhibits, in a dorsal view of the animal (fig. 3), an almost pentagonal form, projecting somewhat between the bases of the antennæ, without, however, forming any true frontal lobe. The cervical segment is well defined, and in the female is almost as long as the fore-part of the head. Its lateral expansions, containing the shell-gland, are very conspicuous.

The trunk has the normal number of segments, but appears somewhat depressed, its width considerably exceeding its height (comp. figs. 2 and 3).

The genital region in the female (fig. 1) is very large, about equalling in length half the trunk, and it has its 2 segments only defined dorsally. Ventrally this region is continued in the very capacious marsupium, which is not, as in *Streptocephalus*, prolonged behind to a freely projecting pouch. In the male (figs. 2 and 3) this region is considerably smaller, though more than twice as long as the succeeding caudal segment.

The tail is comparatively much shorter than in the preceding species, and does not nearly attain the length of the trunk. It tapers slightly distally, and has the segments very sharply marked off from each other, and considerably broader than they are long. The last segment, as usual, is the shortest, somewhat flattened, and, especially in the male, expanded distally (see fig. 3).

The compound eyes (see fig. 4) are rather strongly dilated distally, and distinctly claviform in shape. The ocellus occupies its normal place.

The antennulæ are very slender and elongated, especially in the male, considerably exceeding the length of the head including the cervical segment.

The antennæ in the female (fig. 1) exhibit an appearance rather similar to that in *Streptocephalus gracilis*. In the male (figs. 2, 3, 4), however, they are very different, more resembling those in the male of *Branchipus* or *Chirocephalus*. They are comparatively short and robust, consisting each of a very thick and muscular basal part, and a strongly chitinized, claw-shaped terminal part, both very movably articulated together. The basal part is very massive, and exhibits a somewhat irregular form, both the outer and inner faces being angular in the middle. From the inner side, moreover, issue 2 differently formed projections, the anterior being rather large and bidentate at the tip, the posterior having the form of a small linguiform lobe. In Brauer's species a similar lobe occurs, but of the bidentate projection no trace is seen, and the antennæ on the whole are far less robust than in the present species. The terminal part has its articulation within a hollow of the basal part, and exhibits the form of a slender, strongly curved claw, without any crests and denticles. It terminates in an obtuse point, which meets the corresponding point of the other side, when the antennæ are bent in against each other. The prehensile character of these antennæ is very obvious.

The oral parts do not seem to exhibit any peculiarity in their structure, except that in the male, just in front of the labrum, and behind the insertion of the antennæ, there is a small spinulose papilla, of which no trace is found in the

female. A similar papilla is also found in Brauer's species, and is by that author regarded as homologous with the frontal lobe in the male of *Streptocephalus*, a supposition which, however, is quite inadmissible, since it occupies a very different place.

The branchial legs (figs. 5—7) are on the whole constructed upon the very same type as in *Streptocephalus*, though, on a closer comparison, some well-marked differences may be found to exist. Thus, the basal plate in all the pairs has the edge divided into coarse serrations; the epipodite is comparatively larger; and the terminal lobe of the endopodite in all the pairs from the 2nd to the 8th has the inner corner produced to a blunt, tooth-like projection, exhibiting, moreover, at some distance above it another similar, but much smaller projection (see fig. 6). The 1st and last pairs (figs. 5, 7) exhibit differences from the middle pairs analogous to those found in *Streptocephalus*.

The marsupium in the female (fig. 1), as above stated, forms a very large and capacious sac-like expansion of the genital region. Its form is broadly ovate, with the posterior extremity but very slightly prominent, and scarcely extending beyond the limits of the genital region. The valvular orifice is bordered by 2 short, evenly rounded lips.

The sexual appendages in the male (fig. 2) exhibit an appearance similar to that in the male *Streptocephalus gracilis*.

The caudal rami are very different in the two sexes. In the female (fig. 1) they somewhat resemble those in *Streptocephalus gracilis*, though they appear comparatively more elongated, attaining almost half the length of the tail. In the male these rami (see figs. 2' and 3) exhibit quite an extraordinary development, and, when fully extended, even equal in length

the whole tail. In the living animal they are greatly curved, and carried in such a manner, as to form a pair of much bowed tongs, their very slender distal parts curving inwards against each other, and the tips being curled up anteriorly. Along the whole outer edge and the proximal part of the inner, they are fringed with comparatively short setæ, whereas the distal part of the inner edge is divided into a number of small tooth-like projections. In Brauer's species the caudal rami are stated to be of exactly the same appearance in the two sexes.

The body in both sexes is highly pellucid, with a slight yellowish tinge, sometimes changing to light carneous. In fully grown specimens each of the caudal segments generally exhibits ventrally a transverse, orange band, and in the male, moreover, the frontal part of the head, as also the caudal rami, are tinged with light orange or yellow. The marsupium of the female is richly coloured, exhibiting several beautiful tints passing into each other: yellow, orange, crimson and blue.

Development.—I have studied the whole larval development of this form; but as it agrees exactly with that in other Branchipodids, I do not think it necessary to describe it in detail. I only give, on the accompanying plate, figures of 2 different stages, the one, fig. 8, representing the Nauplius immediately after being hatched, and seen from the ventral face; the other, fig. 9, representing a larva in a somewhat later stage, viewed from above. The length of the Nauplius is only 0.44 mm.; that of the larva represented in fig. 9 is 0.82 mm. The whole larval development is gone through in the course of about 4 days, and the animal becomes sexually mature after the lapse of about a fortnight.

Biological Observations.

Several specimens of this pretty form, males and females, also developed in my aquaria, and were kept alive until late in the summer. When fully grown, they were readily distinguished from the other Branchipodid described above by their less slender form, but especially by the different shape of the marsupium in the female, and of the prehensile antennæ in the male. The latter, moreover, was easily recognized by the enormous development of the caudal rami. For a closer examination, the specimens were transferred to separate aquaria not containing specimens of the other Branchipodid. In habits the two forms agree, in as much as they are never found at the bottom, like the species of *Apus* and *Estheria*, but always freely suspended in the water. The manner in which the swimming movements are effected, is likewise the same in both forms, and also the attitude of the body. But the degree of agility in the present form is rather different according to the sexes. In the ovigerous female the motions seemed to be very much encumbered by the heaviness of the large marsupium, and she was often found for a long time occupying nearly the same place in the aquarium, only slowly turning round on her axis, though the branchial legs were seen to be in rapid swinging motion. The male, on the other hand, scarcely stopped for a moment, but swam about with great agility in all directions, and it was very difficult indeed to catch it by the ordinary means.

In this form I was equally unsuccessful in witnessing the copulative act, though the specimens were watched nearly every day. The female deposited her eggs at short intervals, and, unlike what was the case with *Streptocephalus gracilis*,

these eggs were at once hatched. But, although the aquaria at times literally swarmed with larvæ belonging to this 2nd generation, none of them reached maturity, apparently owing to the superabundance of their enemies (especially Cypridids) at that time in all the aquaria. It appeared also that the larvæ were to a great extent devoured by their own parents, being involuntarily, by the swinging motions of the branchial legs of the latter, whirled in between them, and together with other small particles carried within the reach of the oral parts.

4. **Estheria Elizabethæ**, G. O. Sars, n. sp.

(Pl. IV).

Specific Characters.—Shell of female moderately tumid and, seen laterally, of broadly oval form, with the greatest height somewhat exceeding $\frac{2}{3}$ of the length, umbones distinctly prominent, and occurring far in front of the middle, dorsal edge behind the umbones nearly straight, and terminating in a slight angle, ventral margin evenly curved, anterior extremity obtusely rounded, posterior obliquely expanded.—Shell of male somewhat less tumid, and, seen laterally, considerably narrower, posterior angle of dorsal edge obsolete, ventral margin less curved, being nearly straight in the middle, anterior extremity obtusely truncated, posterior considerably produced, and narrowly rounded at the tip. Valves in fully grown specimens with from 20 to 24 very distinct, ridge-like concentric ribs, placed at rather regular intervals, and fringed in their posterior part with short, flattened bristles, especially very distinct

on the outermost ribs; surface of shell between the ribs smooth, or very finely punctate. Rostrum in female terminating in a somewhat procurved blunt point; that in male considerably larger, and obtusely rounded at the tip; cervical sulcus in both sexes very deep and narrow. 23 pairs of brauchial legs present in both sexes, epipodite in some of the pairs unusually prolonged; the 2 anterior pairs in male transformed in the usual manner, and having the hand smooth inside. Tail-piece with the unguiform processes of the caudal plates in female of the usual appearance, in male very asymmetrical, the right process being much curved, and projected at rather a long distance above the left; caudal claws setiferous at the base, outer part finely denticulate inside. Colour of shell corneous, of enclosed animal dark red. Length of shell in female 7 mm; in male 8 mm.

Remarks.—The present species would seem to be nearly allied to *E. cycladoides*, Joly, with which I was at first inclined to identify it. After having consulted the original description of the species by Joly, and that subsequently given by Dr. E. Simon, I find, however, that it differs in several points, both as to the shell and the enclosed animal, and is thus entitled to be regarded as a distinct species. It is also rather like the Australian species *E. Packardi*, Brady, described in detail by the present author in another paper inserted in this Journal; but in this instance too, there are some well-marked differences to be found, which do not permit the combination of the 2 forms into one and the same species. Thus, the concentric ribs of the valves in the present species are much more prominent, and the interspaces between them are quite smooth, not as in the Australian species, striolate. Moreover the rostrum of the female is of somewhat different form, and the number

of legs is greater, viz., 23 pairs (in *E. Packardi* only 20). The unusually large development of the epipodite in some of the legs, is another character by which the present form distinguishes itself from most other species. Finally, the asymmetry of the terminal processes of the caudal plates in the male is more conspicuous than in any other species with which I am acquainted.

Description.—The length of the shell in apparently fully grown female specimens amounts to 7 mm., by a height of about 5 mm. That of male specimens is somewhat larger, attaining a length of 8 mm., by a height of not quite 5 mm.

As to form, the shells of female and male specimens exhibit rather conspicuous differences, enabling them to be readily distinguished without any examination of the enclosed animal. In the female, it exhibits, seen from the side (fig. 1), a somewhat irregular, broadly oval form, with the greatest height slightly exceeding $\frac{2}{3}$ of the length. The umbones are rather prominent, and placed much nearer the anterior than the posterior extremity, though scarcely so far in front as in *E. Packardi*. The dorsal margin, behind the umbones, is nearly straight, and exhibits, at its junction with the free edges of the valves, a rather slight angle. The ventral margin forms a tolerably even curve, and passes without any interruption into the anterior and posterior margins. The anterior extremity of the shell, in front of the umbones, occupies about $\frac{1}{4}$ of the length of the shell, and appears, in a lateral view of it, obtusely rounded, whereas the posterior extremity expands obliquely from the dorsal angle, being narrowly rounded at the tip. Seen from above (fig. 2), the shell appears moderately tumid, with the greatest width, occurring across the umbones, almost attaining half the length.

The shell of the male appears on the whole narrower than that of the female, and has the edges less regularly curved. Seen from the side (fig. 3), it exhibits a somewhat elliptical form, with the height not nearly attaining $\frac{2}{3}$ of the length. The dorsal margin here too, is straight and horizontal, but the angle between it and the free posterior edges of the valves is nearly obsolete. The umbones are rather prominent, and occupy the same place as in the shell of the female. The inferior edges of the valves are less curved than in the female, being almost straight in the middle, and of the extremities, the anterior one appears bluntly and somewhat obliquely truncated, whereas the posterior one is still more prominent than in the female, with the tip evenly rounded. Seen from above (fig. 4), the shell appears less tumid than in the female, though of a similar irregular fusiform shape.

The surface of the valves in both sexes is sculptured by a number of very distinct concentric ribs, representing the lines of growth. These ribs, the number of which of course increases with age, may in fully grown specimens amount to from 20 to 24 in each valve. They are distinctly elevated, ridge-like, and placed at rather regular intervals, the 1st one encircling the umbo, the last running along the free edge of the valve. In front, the ribs converge to one point in close approximation to the umbo, whereas behind they terminate at some distance from each other along the dorsal margin, giving it a more or less distinctly crenulated appearance. On a closer examination, the greater number of the ribs are found to be fringed in their posterior part with short, flattened bristles, and on the outermost ribs this fringe is very conspicuous, as it occupies the greater part of their length (see fig. 3 a). The surface of the shell

between the ribs is nearly smooth, without any distinct reticulation or striation (see fig. 1 a).

The enclosed animal exhibits the structure characteristic of the genus. Figs. 5 and 6 on the accompanying plate represent the whole body of a female and a male specimen as exactly as possible, both exhibited from the left side. The sexual differences are very obvious, and are expressed in the rather dissimilar form of the rostral part of the head, the different development of the antennulæ, the transformation of the 2 anterior pairs of legs in the male to prehensile organs, and partly also in the somewhat different structure of the tail. As I have elsewhere given a detailed description of the several parts of the body and its appendages in the nearly-allied species *E. Packardi*, it may be sufficient here only to point out some of the more conspicuous differences between the 2 species.

As to the form of the head, its rostral part appears in the present species somewhat more prominent than in the Australian form, the distance from the tip of the rostrum to the ocular prominence equalling in the female (see fig. 5) the distance from that prominence to the cervical sulcus, whereas in *E. Packardi* it is considerably shorter. The tip of the rostrum, moreover, which in *E. Packardi* is quite simple, is produced in the present species to a slightly procurved, blunt point. Finally, the fornix is less abruptly bent in the middle than in the above-mentioned species. In the male (fig. 6) the rostrum is still larger, and is obtusely rounded at the tip.

The antennulæ in the male (fig. 6) are considerably larger than in the female (fig. 5), fully equalling the head in length; their lateral lobules are very prominent, and the outer part distinctly articulated (see fig. 7).

The legs, on the whole, are constructed in a very similar manner to that found in *E. Packardi*, but their number is greater, 23 pairs being distinctly counted in both sexes, and perhaps a 24th rudimentary pair may yet be present behind the others. On a closer examination, the epipodites are found in some of the pairs to attain quite an unusual development, as shown by figs. 5 and 6. They successively increase in length from the 1st to about the 7th pair, where they reach their maximum length, nearly equaling that of the endopodite (see also fig. 11). From the 1st pair they again successively diminish in size. In *E. Packardi* these parts are much more uniform in size, and in none of the legs exceed half the length of the endopodite.

The structure of the 2 anterior pairs of legs in the male, (figs. 9, 10) agrees almost exactly with that in *E. Packardi*. As in that species, the hand has the inner edge quite smooth (see fig. 9 a), whereas in *E. cycladoides*, according to the statement of Dr. Simon, it forms behind the thumb a well-marked angular projection. In the succeeding pairs (see fig. 11) a slender biarticulate appendage is appended to the penultimate lobe of the endopodite, as in the male of most other species.

The tail, or caudal piece, exhibits in the female (fig. 5) a similar structure to that in the Australian species. In the male (fig. 6), on the other hand, the terminal, claw-like processes of the caudal plates are much stronger, and very asymmetrical, the right one being considerably more curved than the left, and projected at rather a long distance above it (see also fig. 8).

The colour in living specimens is reddish brown, with a dark shadow extending on each side from the umbones

obliquely backwards, and another smaller shadow on each side of the anterior extremity of the shell. This colour, however, is chiefly due to the enclosed animal, which exhibits a more or less dark red hue, whereas the shell itself is semi-pellucid, and of a rather uniform corneous colour.

Biological Observations.

In the greater number of my aquaria some specimens of the present Phyllopod developed, though at first they were not easy to detect, owing to their peculiar habits; for they remained, as a rule, deeply buried in the loose bottom-deposit. Only occasionally were they seen moving freely through the water in a rather violent and abrupt manner, but these motions seldom endured for any length of time; the animals very soon sank again to the bottom, burrowing deeply in the mud, where they remained apparently immovable. On a closer examination, however, the branchial legs were seen to be in almost uninterrupted swinging motion, for the purpose of breathing, and the acquiring of food. Male and female specimens were present in about the same number, and not infrequently they were seen locked together for rather a long time, the male having a very firm grasp of the female by the aid of his powerful prehensile legs. It is not improbable that a great number of eggs were deposited in the aquaria in the course of the summer; but they did not develope to a new generation.

Explanation of the Plates.

PL. I.

Apus numidicus, Grube.

- Fig. 1. Fully grown male, drawn from life, dorsal view; magnified about $3\frac{1}{2}$ diameters.
- » 2. Fully grown female, exhibited in the same attitude and with the same amplification.
 - » 3. Leg of 2nd pair in male, magnified about 13 diam.
 - » 4. Same leg in female.
 - » 5. Extremity of tail, with bases of the caudal filaments, dorsal view.
 - » 6. Same part, ventral view.
 - » 7. Part of a caudal filament, highly magnified.
 - » 8. Ovum in the moment of protrusion of the embryo-capsule, magnified about 20 diam.
 - » 9. The embryo-capsule, after having escaped from the ovum, with the enclosed nauplius in a lateral view; magnified 56 diam.
 - » 10. Just hatched larva (nauplius); ventral view.
 - » 11. Same larva, after the lapse of 24 hours, ventral view.

Pl. II.***Streptocephalus gracilis*, G. O. Sars.**

- Fig. 1. Fully grown, ovigerous female, drawn from life, and viewed from left side, in the normal attitude of the animal; magnified about 12 diam.
- » 2. Fully grown male, exhibited from right side; same amplification.
 - » 3. Antenna of female, magnified about 28 diam.
 - » 4. Head of male, with the prehensile antennæ protracted; dorsal view; magnified about 12 diam.
 - » 5. Right prehensile antenna of male, viewed from the outer side; magnified 19 diam.
 - » 6. Terminal chela of same, viewed from the inner side.
 - » 7. Anterior maxilla, magnified 35 diam.
 - » 8. Posterior maxilla.
 - » 9. Leg of 1st pair.
 - » 10. Leg of 6th pair.
 - » 11. Leg of 11th or last pair.
 - » 12. Extremity of tail, with the caudal rami, dorsal view, magnified 26 diam.

Pl. III.***Branchipodopsis Hodgsoni*, G. O. Sars.**

- Fig. 1. Fully grown, ovigerous female, drawn from life, and viewed from left side; magnified about 14 diam.
- » 2. Fully grown male, viewed from right side

Fig. 3. Same, dorsal view.

- » 4. Head of male, viewed in front, magnified about 26 diam.
- » 5. Leg of 1st pair, magnified 52 diam.
- » 6. Leg of 6th pair.
- » 7. Leg of last pair.
- » 8. Just hatched larva (nauplius), ventral view; magnified 75 diam.
- » 9. Larva in a somewhat later stage, dorsal view.

PL. IV.

Estheria Elizabethæ, G. O. Sars.

Fig. 1. Shell of a fully grown female, viewed from left side, magnified about 9 diam.

- » 1 a. Part of the shell, at some distance behind the umbo, magnified 26 diam.
- » 2. Shell of female, dorsal view.
- » 3. Shell of a fully grown male, viewed from left side.
- » 3 a. Part of the marginal region of a valve, showing the dense fringe of bristles on the ribs; magnified 52 diam.
- » 4. Shell of male, dorsal view.
- » 5. Body of a fully grown female, extracted from the shell, and viewed from left side; magnified about 14 diam.
- » 6. Body of a fully grown male, viewed as above.
- » 7. Male antennula, magnified 26 diam.

Fig. 8. Caudal piece, with the adjoining part of the trunk from a male specimen, viewed from left side, and magnified about 19 diam.

- » 9. Prehensile leg of 1st pair in male, magnified 19 diam.
 - » 9 a. Terminal part, or hand, of same, more highly magnified.
 - » 10. Prehensile leg of 2nd pair in male.
 - » 11. Leg of 8th pair in male.
-